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and, introducing this, we get

$$\partial C = R \operatorname{tg} C \qquad \dots \qquad \dots \qquad (3)$$

that is to say, the refraction uniformly raises the small circle without interfering with its parallelism to the corresponding vertical great circle. Therefore the effect of refraction in these observations is limited, besides second-order terms, which are amenable to computation, to the comparatively slight departures from the tangent law and to the effects of changes in the density of the atmosphere, both of which are more accurately known within the narrow limits which come into question than the total amount of the refraction for similar zenith distances.

Flexure of the instrument next suggests itself as a source of error. This also will be eliminated to a very great extent if, after observing the equatorial stars, the instrument is reversed in its bearings for the observations on the six-hour circle, as the instrument will then remain very nearly in the same position with regard to the direction of gravity.

It is obvious that the method could be most advantageously used in an observatory on the 45th parallel, where the elimination of errors would be most complete, and that it could not be used at all either near the equator or near the poles.

The declination of suitable stars having been determined, the latitude of the place of observation could be obtained by the zenith telescope or by a transit instrument in the prime vertical, again without involving close readings of graduated circles.

It would seem that this method could be advantageously carried out photographically, photographs of equatorial and six-hour regions being taken on the same plate, the resulting star traces forming approximately right angles with each other and being thus clearly distinguished.

Bedford Park, W.: 1904 *May* 10.

Micrometrical Measures of Double Stars made with the 17¼-*inch Reflector. Second Series.* By the Rev. T. E. Espin, M.A.

In the following list Column 1 gives the number in Σ, OΣ, &c., Column 2 the approximate R.A. and decl. for 1880, Column 3 the position angle, Column 4 the distance, Column 5 the number of nights, Column 6 the magnitudes, Column 7 the date, and Column 8 any notes. In addition to the usual symbols, A.G. refers to stars found double in the Catalogue of the *Astronomische Gesellschaft.* Under the heading Various Stars will be found several new pairs that have been detected since the last list was published, or have been accidentally omitted.

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Σ *Stars.*

Σ	R.A. 1880		Decl.		P.	D.	Nights.	Mags.	Date.	Notes.
	h	m	°	′	°	″				
38	0	28·7	+58	0	145·4	17·25	1	...	04·06	
70		46·7	+52	2	244·6	7·91	1	6·5, 9·4	01·89	
162	1	41·8	+47	18	205·1	1·58	1	...	00·99	AB
					179·6	20·16	1	...	00·99	AC
163		42·6	+64	15	33·8	34·47	2	6·0, 8·3	03·43	
182		47·9	+60	42	304·9	3·38	2	...	04·06	*Comes* 13 mag. 71° ± 32″ ±
230	2	6·5	+57	55	258·2	23·49	2	...	03·87	
272		24·4	+57	56	38·9	2·07	1	8·0, 8·0	03·88	
392	3	1·4	+52	29	346·1	25·09	1	...	01·00	
550	4	22·5	+53	36	306·7	10·24	2	...	01·58	1 Cameli
587		38·5	+52	54	183·6	21·04	2	...	01·51	
603		45·1	+49	23	239·2	8·28	1	...	01·04	
617		52·3	62	50	122·5	12·76	3	8·5, 9·0	04·05	
618		52·5	62	54	210·6	32·44	3	...	04·05	
718	5	23·1	49	19	76·0	7·69	1	6·5, 6·8	99·88	
865	6	4·9	51	12	66·9	5·28	1	...	01·04	
884		11·5	47	11	271·2	9·17	1	8·3, 8·5	01·07	
946		34·2	59	34	129·7	4·34	2	...	04·07	
948		35·6	59	34	112·8	1·44	2	...	04·07	AB 12 Lyncis
					305·9	8·67	2	...	04·07	AC
958		38·2	+55	50	256·2	5·16	2	6·0, 6·0	01·56	
1006		56·0	+62	56	71·8	29·83	1	...	04·05	
1091	7	20·8	+50	13	330·3	28·51	1	...	00·11	
1174		56·1	+47	36	215·0	5·40	1	...	01·11	
1184	8	1·5	+38	14	340·8	26·50	1	8·0, 8·3	00·10	*Comes* 14 mag. 18″ ± 210° ±
1217		15·9	+45	21	241·7	29·07	1	...	00·11	
1263		37·3	+42	10	21·1	53·75	1	...	00·11	
1346	9	17·1	+54	32	312·6	5·45	2	...	01·17	21 Ursæ
1815	14	7·9	+45	45	152·4	8·84	1	...	01·38	
1830		11·9	+57	13	292·1	7·02	2	8·5, 9·0	02·33	AB
					80·5	35·84	2	C = 11·8	02·33	AC
1831		12·3	+57	15	140·3	5·84	2	6·5, 8·5	02·33	
1982	15	45·8	+43	8	301·7	5·42	2	8·9, 9·1	01·44	
2006		58·0	+59	15	194·3	1·42	2	7·5, 9·3	00·96	AB
					218·8	45·04	2	C = 8·7	00·96	AC
2047	16	19·7	+47	55	331·5	2·24	1	...	00·40	
2054		22·2	+61	57	356·2	1·37	4	6·8, 7·2	03·60	

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Σ	R.A. 1880		Decl.		P.	D.	Nights.	Mags.	Date.	Notes.
	h	m	°	′	°	″				
2065		28·5	+40	14	217·1	31·00	1	8·1, 8·6	00·45	
2092		37·4	60	56	2·8	8·49	3	7·8, 8·4	03·57	
2116		54·3	63	42	4·6	19·52	2	8·5, 9·0	03·61	
2124		58·8	65	22	87·1	15·01	2	8·5, 9·0	03·61	
2155	17	14·6	60	50	112·3	9·75	2	6·5, 8·9	03·56	
2180		26·5	50	57	262·9	3·30	2	...	02·57	
2199		36·4	55	48	84·3	1·58	3	7·5, 7·9	02·93	
2218		39·5	63	43	345·2	1·72	3	6·6, 7·8	03·57	
2219		40·1	61	39	99·8	17·61	2	7·6, 8·5	03·56	
2225		41·9	51	59	313·0	8·82	1	9·0, 9·2	03·69	
2273		58·6	64	9	284·1	20·45	2	6·5, 7·0	03·56	
					266·4	24·1	2	C = 12	03·56	(New)
2357	18	32·1	63	37	268·8	4·87	1	...	03·56	
2368		36·1	52	14	326·8	1·74	2	...	03·70	
2420		49·4	59	15	333·9	32·32	3	...	03·65	*o* Draconis
2440		56·1	62	14	122·2	16·78	2	6·5, 8·0	03·58	
2481	19	7·1	38	34	221·6	4·32	1	7·2, 7·4	00·52	
2487		9·7	38	55	83·1	28·13	1	...	00·52	η Lyræ
2554		32·1	59	59	195·4	17·97	2	8·3, 8·6	03·62	
2573		38·3	60	12	27·2	18·13	1	...	03·60	
2604		51·5	63	49	184·3	27·38	4	6·5, 8·5	02·97	
2611		55·2	47	2	206·0	5·40	1	8·1, 8·1	01·64	Both very yellow
2640	20	3·2	63	32	19·6	5·18	3	7·0, 10·0	03·88	
2691		25·2	37	43	32·3	17·22	2	8·0, 8·2	01·57	
2764	21	2·9	61	40	302·2	6·67	2	8·0, 8·3	03·88	
2846		50·1	45	12	266·4	3·32	2	...	01·76	
2896	22	14·6	62	46	241·8	20·95	2	...	02·87	
2906		21·4	36	50	1·1	3·86	1	6·7, 9·2	00·62	
2985	23	4·4	47	18	253·3	15·57	1	6·3, 6·9	01·81	Yellow; yellowish white
3049		52·9	55	6	325·9	3·05	3	...	03·80	σ Cassiopeiæ
3053		56·4	65	26	70·5	14·69	2	...	03·78	

OΣ *Stars.*

59	3	32·3	45	38	350·0	2·72	1	8·0, 8·7	00·11	
158 rej.	6	43·9	51	41	303·5	16·39	1	7·0, 12·5	01·04	
291 rej.	14	56·5	47	45	156·5	35·94	1	...	01·38	
312	16	22·3	61	46	141·5	5·25	3	...	03·60	η Draconis

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Σ	R.A. 1880		Decl.		P.	D.	Nights.	Mags.	Date.	Notes.
	h	m	°	′	°	″				
329	17	20·1	37	3	13·6	32·75	3	7·3, 8·2	00·35	
366 rej.	19	9·8	34	1	230·6	21·28	1	7·5, 8·7	00·57	AB
					141·0	26·1	1	11·7	00·57	AC
					21·7	13·2	1	13·2	00·57	CD

OΣΣ *Stars.*

15	1	13·3	64	0	348·1	52·63	2	6·0, 7·5	03·35	Yellow white, pale red
26	2	11·0	59	29	199·9	63·06	1	...	03·86	
39	3	39·7	56	45	75·1	57·57	2	...	02·51	
44	4	8·6	45	53	321·8	58·49	1	...	01·06	
46	4	11·3	55	13	188·6	34·40	1	7·0, 12·0	01·07	AB (New)
...	...		...		160·2	98·88	1	C 7·2	01·07	AC
87	7	30·4	42	46	178·0	65·10	2	...	00·10	
156	17	29·9	55	14	312·1	61·84	2	...	03·66	ν^1 ν^2 Draconis
163		55·5	62	37	40·1	58·10	2	7·0, 7·1	02·69	
186	19	31·2	59	53	287·0	75·76	2	...	03·62	
194		51·3	59	23	359·6	75·37	1	...	03·64	
242	23	1·0	46	16	31·0	80·34	1	6·9, 7·5	01·81	
247		24·3	57	53	268·9	75·80	1	...	00·86	
...	...		...		254·9	10·92	1	11·0, 11·2	00·86	*h* 1889
...	...		...		114·5	42·79	1	6, 12		*h* 1888
248		40·1	50	0	339·8	22·94	2	6·5, 12·0	02·84	AB (New)
...	...		...		139·9	52·68	2	C = 9·1	02·84	AC
251		47·5	50	52	199·6	43·35	2	...	03·86	

h's Stars.

1066	0	59·0	62	0	297·3	7·32	3	8·6, 11·6	03·57	*h* 302·2
2069	1	35·8	52	41	240·4	20·11	2	9·2, 9·3	00·02	
1091		40·3	61	14	152·3	27·66	2	8·5, 8·9	04·05	
2085		41·9	52	12	60·8	10·18	2	9·3, 9·8	00·47	
2307	6	11·8	54	6	92·0	22·40	1	8·6, 11·5	00·12	
417 756	7	13·8	34	55	69·4	17·60	1	8·5, 13·5	00·10	
2478	8	55·1	56	9	199·4	17·96	2	9·6, 10·7	01·21	
1231	13	19·9	41	5	6·2	22·39	1	8·5, 12·0	01·39	
554	14	27·4	35	15	294·3	12·11	2	8·9, 9·1	02·33	
1261		50·7	58	3	16·3	9·13	2	9·2, 9·3	01·35	B.D. + 58°·1538
2771	15	9·2	54	27	279·7	37·88	1	8·8, 12·5	00·45	*h's* R.A. 1^m too large

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Σ	R.A. 1880		Decl.		P.	D.	Nights.	Mags.	Date.	Notes.
	h	m	°	′	°	″				
2784		24·7	50	3	229·4	17·28	1	9·0, 13·0	00·34	
587	16	35·7	37	46	300·5	16·00	1	8·8, 13·5	00·52	
2802		53·0	39	18	123·5	11·32	1	9·3, 14·0	00·54	
263		57·2	38	8	113·3	18·04	1	9·3, 11·5	00·52	
264	17	3·4	36	10	197·4	12·54	2	9·5, 12·0	00·56	
1342	18	40·3	43	19	185·7	18·80	1	9·0, 12·0	02·65	
1356		52·9	45	17	343·7	29·23	2	8·3, 9·0	01·63	
1357		53·6	45	37	212·1	26·23	2	7·9, 11·7	01·64	
1395	19	20·9	36	53	65·2	3·09	1	9·0, 9·2	01·55	
1439		42·3	55	33	199·6	30·21	2	7·0, 9·0	02·67	*h* 195°·0
2905		46·2	60	57	196·9	8·61	2	9·1, 11·6	02·69	
1457		53·4	37	36	44·2	11·58	1	9·1, 9·2	00·57	
1505	20	17·2	43	14	116·9	16·84	1	8·3, 10·5	00·53	*h* 110°·3
1580		44·2	55	26	246·8	10·70	1	8·9, 12·0	02·68	
1606		56·8	54	4	184·0	17·60	2	9·0, 11·0	03·19	
1654	21	25·5	61	5	30·8	3·98	3	9·1, 9·3	02·99	
1659		29·3	58	8	300·4	6·68	1	8·4, 9·0	00·62	*h* 312°·2
939		30·5	30	28	172·7	14·81	1	8·0, 12·0	00·71	
940		30·5	30	31	290·6	40·72	1	8·0, 10·0	00·71	
1673		34·5	43	48	82·8	5·76	1	8·3, 8·8	00·75	
1687		39·9	45	37	51·0	5·44	1	9·4, 9·9	00·75	*h* 238°·5
1697		44·9	34	18	260·4	8·86	2	8·0, 9·6	00·66	
3072		50·4	58	53	76·8	13·83	1	...	01·01	
1714		56·5	44	46	252·6	16·68	1	8·6, 8·8	00·75	
1788	22	29·6	40	57	300·3	3·18	1	8·4, 9·2	00·62	
1796		33·8	56	10	6·6	29·59	1	5·0, 11·0	02·83	*h* 22°·1
1808		41·2	48	25	317·4	10·06	1	9·5, 9·6	01·76	*h* 133°·1
1860	23	8·5	62	0	355·8	7·75	1	9·0, 11·5	04·02	*h* 14°·9
1876		20·0	36	10	211·6	10·12	1	9·4, 9·6	00·71	
1896		33·3	61	26	115·6	16·33	3	6·8, 11·2	02·77	

Various Stars.

Espin	0	16·4	53	40	191·7	10·23	3	8·4, 9·3	02·91	B.D. + 53°·54
Espin	3	28·1	63	49	171·9	3·71	3	9·9, 10·4	04·05	B.D. + 63°·435
Espin	4	12·7	59	20	58·9	32·14	1	6·0, 8·8	04·07	B.D. + 59°·793
Espin	5	18·5	62	35	222·9	2·32	1	8·7, 10·5	04·06	B.D. + 62°·756
Σ 961 rej.	6	39·9	41	15	48·6	8·04	1	9·2, 10·5	00·14	
A.G.		53·5	40	1	247·7	6·59	2	9·5, 11·5	00·51	BC (New)
					151·3	8·47	2	9·4, 9·5	00·51	AB B D. + 40°·1776

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Σ	R.A. 1880		Decl.		P.	D.	Nights.	Mags.	Date.	Notes.
	h	m	°	′	°	″				
Σ 2069 rej.	16	31·7	34	5	71·3	27·27	1	6·8, 9·4	00·54	
KR. 47	17	51·7	64	16	204·9	8·10	2	8·9, 9·3	03·59	
Σ 2334 rej.	18	24·5	62	51	205·2	14·48	2	...	03·58	
Espin		31·5	58	41	260·0	13·98	2	8·9, 11·9	02·81	
Σ 2353 rej.		31·6	58	36	224·8	11·75	2	8·2, 13·7	02·81	
Σ 2365 rej.		34·4	63	36	23·7	19·71	4	7·5, 9·6	03·24	
Σ 2377 rej.		37·5	63	25	340·7	15·55	3	6·9, 9·8	03·14	
A.G.	19	9·4	47	34	228·9	5·24	2	8·5, 8·7	01·65	B.D. + 47°·2782
A.G.		44·7	51	36	258·4	13·47	3	8·4, 9·3	03·00	B.D. + 51°·2683
—	20	1	35	35	149·1	96·47	2	...	01·59	Sh. 314, Sh. 315
Espin		42·5	57	9	162·7	68·65	3	5·0, 8·7	02·83	B.D. + 57°·2240
A.G.		47·2	44	36	251·3	9·48	1	8·8, 9·1	00·75	B.D. + 44°·3603
A.G.		48·0	53	36	361·1	9·47	2	8·7, 8·8	02·73	AB B.D. + 53°·2506
					250·5	13·04	2	C = 12·5	02·73	AC
Σ 2772 rej.	21	5·5	53	52	230·5	11·44	1	...	00·75	
A.G.		14·2	38	39	112·8	5·78	2	8·4, 9·3	00·76	B.D. + 38°·4442
Holmes		16·6	58	11	244·2	12·75	2	9·0, 9·1	02·78	B.D. + 58°·2252
A.G.		27·0	44	37	181·8	4·08	1	9·0, 9·3	00·79	B.D. + 44°·3852
Σ 2808 rej.		30·5	30	28	321·6	19·12	...	...	00·71	
Σ 2844 rej.		48·6	64	20	258·5	11·16	2	8·0, 10·0	03·74	
Espin	22	51·9	64	9	330·5	2·76	1	11·0, 12·0	02·73	BC
					296·4	19·13	1	A = 10	02·73	AB (*h* 1833)
Espin	23	15·6	61	45	...	4 ±	...	11·5, 12·5	04·02	BC
						30 ±	...	A = 8·0	04·02	AB B.D. + 61°·2430

The Society has received the following circular letter from the Weather Bureau of the United States Department of Agriculture. The Council has directed that the letter should be published in the *Monthly Notices*.

U.S. Department of Agriculture:
Weather Bureau, Washington, D.C.
April 15, 1904.

Sir,—You may have noticed that records have been published by Messrs. C. Dufour, of Lausanne; H. H. Kimball, S. P. Langley, and C. G. Abbot, of Washington; Max Wolf, of Heidelberg; and Gorczynski, of Warsaw, showing that an appreciable general diminution of the transparency of the Earth's atmosphere took place some time during the year 1902, but disappeared at some time during 1903. This is an important

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matter, and may possibly be made the basis of an explanation of other meteorological phenomena. I beg to ask whether you have any records that will assist in defining the dates of beginning and ending, and the extent of this change in transparency. Such records may consist of photometric or photographic observations of the brightness of the stars; changes in the solar or stellar spectra; unusual prevalence of halos, large Bishop's ring, or haze; observations of heat received from the sun, as made with actinometers or pyrheliometers; observations of the polarisation of the blue sky light and of scintillation of the stars.

Undoubtedly this diminution and increase of transparency began and ended at different dates in different places, as the phenomena spread gradually over the world during the years 1902 and 1903; additional records are therefore desired in order to trace its progress. Will you not kindly examine your records from this point of view and send me the result for publication in a general article on this subject?

Very respectfully,
CLEVELAND ABBE,
Professor and Editor.

Errata.

Annual Report of the Council, page 333.

The Report of the Kodaikanal Observatory was communicated by Mr. C. P. Butler, who was in charge of the Observatory during the Director's absence in England.

Prof. Turner's Paper on Time of Sunset.

Page 193, line 18, *for* Belfast *read* Southport.